REMARKS

In response to the Official Action mailed February 20, 2002, Applicants amend their application and request reconsideration. In the Amendment, claims 1-4 and 11 have been amended to more clearly define the invention, and claim 5 has been cancelled. No new matter has been added. Claims 1-4 and 11 are now pending and under examination.

Claims 3 and 5 were objected to for containing informalities. The objection to claim 5 has been rendered moot by its cancellation, and the objection to claim 3 has been overcome by the amendments to claim 3.

Claims 1, 2 and 4 were rejected under 35 U.S.C. §103(a) as being unpatentable over Matsumoto et al. (U.S. Patent 5,122,000). Claims 3 and 5 were rejected under 35 U.S.C. §103(a) as being unpatentable over Matsumoto et al. in view of Tanaka et al. (U.S. Patent 6,086,686). Claim 11 was rejected under 35 U.S.C. §103(a) as being unpatentable over Matsumoto et al. The rejection of claim 5 has been rendered moot by its cancellation. For the following reasons, it is respectfully submitted that claims 1-4 and 11 are patentable over the cited references.

There are several reasons why claims 1-4 and 11 are patentable over the cited references. The first reason is that the ranges of claims 1-4 and 11 of the present application are not disclosed or suggested by the cited references.

As described in the specification, the present invention addresses a problem associated with prior art steel materials used to make roller bearings, such as roller bearings used in the spindles of magnetic disk driving devices. The problem is that while high-temperature tempering can reduce undesirable residual austenite in bearing materials, which is produced by hardening, it also reduces surface hardness and thus rolling contact fatigue life of the bearing materials (see the specification at page 2, lines 6-21).

Applicants discovered that a steel bearing material, which contains alloy ingredients within the ranges of C: 0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to 1.50% by weight (see claims 1-4 and 11), can be used to overcome the problem associated with conventional steel bearing materials. As described in the specification, tests conducted by Applicants show that, with the steel bearing materials of claims 1-4 and 11, residual austenite can be reduced to 0% by volume with low-temperature tempering (see, for example, page 13, line 4 to page 14, line 11). As a result, not only the undesirable residual austenite is reduced to 0% by volume, surface hardness of HRC of 62 or above, produced by hardening, is preserved because the tempering temperature is low.

According to the Examiner, however, Matsumoto et al. discloses the steel bearing materials of the present invention. Specifically, the Examiner asserted that Table 1 of Matsumoto et al. discloses a steel containing alloy ingredients of 0.2 to 1.23 wt% C, 0.4 wt% or less Si, and 1 wt% and 2 wt% Cr.

Applicants respectfully disagree because Table 1 of Matsumoto et al. does not disclose this alleged steel material. In fact, none of the species in Table 1 has alloy ingredients that are within, or even close to, the ranges of claims 1-4 and 11 of the present application. For example, only steel species A and M in Table 1 have a Cr content that is within, or even close to, the Cr range of claims 1-4 and 11, i.e. the range of Cr: 1.0-1.5% by weight. However, the C content (0.21%) of species A and M is not even close to the range of C (0.8 to 1.2%) specified by claims 1-4 and 11. In addition, none of the steel species in Table 1 has C content that is within the range of C content (0.8 to 1.2%) specified by claims 1-4 and 11.

Table 1 of Matsumoto et al. merely discloses 14 steel species (A-N) that have various combinations of alloy ingredients. The Examiner stated that Table 1 discloses a range of C: 0.2 to 1.23 wt% when Table 1 merely discloses one steel species (B) having C = 0.2 wt% and another steel species (K) having C = 1.23 wt%. This way of thinking is improper because it would lead to the clearly

erroneous conclusion that a material having 50% of an ingredient is anticipated by two materials, one of which has 1% of the ingredient, and the other has 99% of the ingredient, on the ground that the combination of the two materials discloses a range of 1-99% of the ingredient. Accordingly, Table 1 does not disclose a steel species having a range of C: 0.2 to 1.23 wt%.

In addition, because none of the steel species in Table 1 has alloy ingredients that are even close to all the ranges of claims 1-4 and 11, the Examiner had to select the content of one ingredient from one steel species and the content of another ingredient from another steel species to arrive at the alleged ranges of ingredients used in the rejection of the present application. This selective picking of ranges of ingredients from different materials is also improper because it would lead to a clearly erroneous conclusion that a material having 20% of ingredient A and 20% of ingredient B is anticipated by two materials, one of which has 20% of ingredient A, and the other has 20% of ingredient B.

In addition, the Examiner's selective picking of ranges from different materials to arrive at the ranges of the present invention can only come about with hindsight provided by Applicant's disclosure. Without the hindsight provided by Applicants' disclosure, one with ordinary skill in the art would not have contemplated the Examiner's specific selection of ranges from different steel species. Such hindsight rejection of Applicants' invention is not permitted under the law.

The Official Action appeared to admit that Matsumoto et al. does not disclose alloy ingredients that are within the ranges of claims 1-4 and 11 of the present application (see the Response to Argument). But the Examiner argued that "the teachings of Matsumoto et al. must be considered in their entirety, and a reading of Matsumoto et al. cannot be limited to just the Examples." Applicants agree that the teaching of Matsumoto et al. must be considered in its entirety. But the requirement that a reference's entire teaching must be

considered does not lead to the conclusion that discrete values from different steel materials can be combined to form ranges used as the basis of a rejection. The MPEP appears to suggest this is improper. In the only case cited by the MPEP concerning the patentability of multiple ranges, only one prior art material is used as the basis of a rejection, and this material has ingredients that fall within all the claimed ranges (see the first case cited in Section 2131.03). If the Examiner maintains that discrete values from different steel materials can be combined to form ranges used as the basis of a rejection, Applicants respectfully request that they be provided with the authority supporting such a proposition so that they can prepare a suitable response.

There is also further evidence that none of the materials of Matsumoto et al. has alloy contents that are similar to those of the present invention. For example, Matsumoto et al. teach that "high temperature tempering (450-600°C) is more preferred than low temperature tempering (for example, at 160-200°C), because the retained austenite can be transformed into a martensite..." (see column 5, the first full paragraph). In other words, Matsumoto et al. teach that low temperature tempering cannot eliminate austenite. This indicates that Matsumoto et al. did not realize it is possible to reduce austenite to 0% with low temperature tempering. Therefore, the bearing materials of Matsumoto et al. have the same problem associated with the prior art bearing materials discussed in the background section of the present application. This is not surprising because, as discussed above, none of the steel species disclosed by Matsumoto et al. has alloy ingredients that are even close to the ranges specified by claims 1-4 and 11. If Matsumoto et al. had been in procession of the claimed invention, they would have realized that the residual austenite could be reduced to 0% with low temperature tempering.

The second, alternative reason why claims 1-4 and 11 are patentable over the cited references is that because it was not expected in the prior art that low temperature tempering can reduce austenite to 0% (as evidenced by Matsumoto et al.), an unexpected result, i.e. the reduction of austenite to 0% with low

temperature tempering, is achieved by the invention defined by claims 1-4 and 11. Because the claimed invention achieves an unexpected result and because its critical ranges are not specifically disclosed by the cited references, it cannot be rendered obvious by the cited references (see MPEP, 2144.05, III, first paragraph).

Since the claimed invention achieves an unexpected result and since the art of metallurgical technology is extremely unpredictable, it is highly improper to predicate the alleged disclosure of multiple ranges based on ingredient contents from more than one steel species. For example, a steel material having 20% of ingredient A and 20% of ingredient B can have properties that are very different from those of a material having 20% of ingredient A or a material having 20% of ingredient B. In addition, it is also highly improper to predicate the alleged disclosure of a range based on two discrete points outside the range. For example, a steel material having ingredient A in the range of 20 to 30% can have properties that are very different from those of a material having 15% of ingredient A or a material having 35% of ingredient A.

The pending claims also recite another patentable feature: the amount of residual austenite over the entire cross section of the one of the inner ring, the out ring and the rolling element is 0% by volume. This feature is not disclosed or suggested by the cited references. In fact, it is not even addressed in the Office Action.

In light of the foregoing remarks, this application is considered to be in condition for allowance, and early passage of this case to issue is respectfully requested. If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and

please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #313MC/48531).

July 22, 2002

Respectfully submitted,

Herbert I. Cantor
Registration No.
Song Zhu
Registration No. 44,420

CROWELL & MORING, LLP
Intellectual Property Group
P.O. Box 14300
Washington, DC 20044-4300
Telephone No.: (202) 624-2500
Facsimile No.: (202) 628-8844
HIC:SZ:tlm (CAM #: 38921.001)

VERSION WITH MARKINGS SHOWING CHANGES MADE

IN THE SPECIFICATION

On Page 5, the paragraph between 16 and 22 has been amended as follows:

C is an element for rendering the starting blank into [maltensite] martensite by hardening/tempering treatment to provide the steel with hardness. If the C content is less than 0.80% by weight, the surface hardness HRC of 62 or more can not sometimes be obtained. If the C content exceeds 1.20% by weight, not only the effect of C for improving the hardness is saturated but also residual austenite tends to be formed.

On Page 10, the paragraph between lines 5 and 18 has been amended as follows:

In a preferred embodiment of the rolling bearing according to the present invention, at least one of the inner ring and the outer ring is formed of a steel material containing alloying ingredients within a range of C: 0.80 to 1.20% by weight, Si: 0.60% by weight or less, Mn: 0.25% by weight or less, Cr: 1.00 to 1.50% by weight, and Mo: 0.60 to 1.50% by weight (steel material ①) and then applied with hardening/tempering, the amount of residual austenite is 0% by volume and the surface hardness is HRC of 62 or more, and the rolling element is formed of a [maltensitic] martensitic stainless steel, applied with hardening/tempering and then with nitridation to form a nitride layer at a thickness of 3 μm or more on the surface and then finished to a surface roughness of 0.1 μm Ra or less.

The paragraph bridging pages 10 and 11 has been amended as follows:

According to this rolling bearing, since the inner ring and/or outer ring are formed of steel material ①, the amount of the residual austenite of 0% by volume

and the surface hardness HRC of 62 or more can be attained without applying the surface hardening treatment as described above. As a result, a sufficient rolling contact fatigue life and a sufficient impact resistance can be obtained as a rolling bearing for use in HDD spindles. Further, since the rolling element is formed of a [maltensitic] martensitic stainless steel, applied with hardening/tempering and then applied with nitridation to form a nitride layer at a thickness of 3 μm or more on the surface and then finished to a surface roughness of 0.1 μm Ra or less, the heat resistance and wear resistance are increased.

On Page 26, the paragraph between lines 16 and 22 have been amended as follows:

Further, rolling bearings excellent both in the rolling contact fatigue life and rotational accuracy can be provided at a reduced cost by forming at least one of the inner ring and the outer ring with the steel material as defined above (steel material ①), even when rolling elements made of ceramics or rolling elements made of [maltensitic] martensitic stainless steel and applied with nitridation were used.

IN THE CLAIMS

1. (Twice Amended) A rolling bearing in which at least one of an inner ring, an outer ring and a rolling element is formed of a steel material containing alloy ingredients each within a range of C:0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to 1.50% by weight, then applied with hardening/tempering, the amount of residual austenite over the entire cross section of the one of the inner ring, the outer ring and the rolling element is 0% by volume and a surface hardness of the raceway surface of the inner and the outer ring and the rolling surface of the rolling element is HRC of 62 or more.

2. (Twice Amended) A rolling bearing in which at least one of an inner ring and an outer ring is formed of a steel material containing alloy ingredients each within a range of C:0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to 1.50% by weight, then applied with hardening/tempering, the amount of residual austenite over the entire cross section of the one of the inner ring and the outer ring is 0% by volume and a surface hardness <u>of the raceway surface of the inner and the outer ring</u> is HRC of 62 or more, and in which a rolling element is formed of a steel material containing alloy ingredients each within a range of C:0.3 to 0.6% by weight, Si:0.3 to 1.5% by weight, Mn:0.3 to 1.7% by weight, Cr:0.5 to 2.5% by weight and Mo:0.6 to 3.0% by weight, with the O content being 9 ppm or less, applied with carbo-nitridation and then applied with hardening/tempering, the amount of residual austenite over the entire cross section of the rolling element is 0% by volume and a surface hardness <u>of the rolling surface of the rolling element</u> is HRC of 62 or more.

3. (Twice Amended) A rolling bearing in which at least one of an inner ring and an outer ring is formed of a steel material containing alloy ingredients each within a range of C:0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to 1.50% by weight, then applied with hardening/tempering, the amount of residual austenite is 0% by volume and a surface hardness <u>of the raceway surface of the inner and the outer ring</u> is HRC of 62 or more, and in which the rolling element is formed of a [maltensitic] <u>martensitic</u> steel, applied with hardening/tempering and then applied with nitridation to form a nitride layer at a thickness of 3 μm or more on the surface and then applied with finishing to a surface roughness of 0.1 μm Ra or less.

4. (Twice Amended) A rolling bearing in which at least one of an inner ring and an outer ring is formed of a steel material containing alloy ingredients each within a range of C:0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to

1.50% by weight, then applied with hardening/tempering, the amount of residual austenite over the entire cross section of the one of the inner ring and the outer ring is 0% by volume and a surface hardness <u>of the raceway surface of the inner and the outer ring</u> is HRC of 62 or more, and in which a rolling element is formed of ceramics.

11. (Amended) A rolling bearing in which at least one of an inner ring and an outer ring is formed of a steel material containing alloy ingredients each within a range of C:0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to 1.50% by weight, then applied with hardening/tempering, the amount of residual austenite over the entire cross section of the one of the inner ring and the outer ring is 0% by volume and a surface hardness <u>of the raceway surface of the inner and the outer ring</u> is HRC of 62 or more, and in which a rolling element is formed of a steel material containing alloy ingredients each within a range of C:0.3 to 0.6% by weight, Si:0.3 to 1.5% by weight, Mn:0.3 to 1.7% by weight, Cr:0.5 to 2.5% by weight and Mo:0.6 to 3.0% by weight, with the 0 content being of 9 ppm or less, applied with carbo-nitridation and then applied with hardening/tempering, the amount of residual austenite is 0% by volume and a surface hardness <u>of the rolling surface of the rolling element</u> is HRC of 62 or more.